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10/644,363	08/20/2003	Thilaka Sumanaweera	2003P05926US	6403

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EXAMINER	
JAWORSKI, FRANCIS J	

ART UNIT	PAPER NUMBER
3737	

DATE MAILED: 09/29/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/644,363	Applicant(s) SUMANAWEERA ET AL.	
	Examiner Jaworski Francis J.	Art Unit 3737	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-27* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,2,4-6,8-10,13,15-18 and 21-25* is/are rejected.

7)☒ Claim(s) *3,7,11,12,14,19,20,26 and 27* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *08202003*.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

[Parenthesized claim number(s) pertain to the claim or claims addressed by the immediately preceding argument.]

Claims 1, 4 – 6, 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Heimdal et al (US6776759) in view of Criton et al(US6537221).

Heimdal et al is directed to a method for computing the strain rate or spatial gradient (i.e. derivative of strain with respect to range) for realtime strain rate medical imaging, comprising the steps of:

(a) determining a spatial gradient of a data sample point velocity in the acoustic domain,

[that is, Doppler data packet ensembles are acquired into Doppler processor stage 90, then the complex autocorrelation of range points e.g. 141, 142 along the scanline of origin and phase lag or differential between these successive range points is computed and is proportional to strain rate for the gradient calculation of equation (3) in Strain Rate Processor 100, see col. 2 top and col. 2 line 29 discussion of this term as the spatial velocity gradient and col. 8 line 42 – col. 9 line 22 pertaining to this calculation's enactment.] and

(b) transforming the calculated spatial gradient to a Cartesian coordinate system in scan conversion stage 120 as scan conversion to video raster format is conventionally understood, see col. 9 lines 23 – 39.

Alternately stated, Heimdal et al is directed to a real-time ultrasound strain rate imaging system which therefore does not use typical post-processing gradient calculations as applicants' describe in their prior art para [0002] but rather computes the gradients on-the-fly in the acoustic domain and then scan converts them for immediate display.

As such, Heimdal et al does not specifically describe determination of the gradient **vector** as a result however directionality is preserved in stage 100 by operation on complex Doppler data, and in the alternative embodiment of col. 9

lines 39 – 63 strain rate is computed as a real not complex quantity meaning that there is flexibility proposed to the manner of obtaining the gradient result.

It would have therefore been obvious in view of Criton et al col. 12 lines 33-40 to obtain a vector spatial gradient result in order to reference the gradient to the direction of tissue motion along a computed cardiac border for example, since Criton et al is directed to strain rate imaging, see col. 15 lines 28 – 51, and in its implementing Fig. 16 element 430 corresponds to Heimdal et al 90, 100 and element 440 to Heidahl et al 120. (Claim 1)

Heimdal et al is directed to 2D imaging, see col. 9 lines 35 – 38; Criton et al is directed to both 2D and 3D imaging. (Claim 4).

In Heimdal et al in the HSRR step 103 filtering is practiced on the strain rate data. Additionally final spatial or temporal averaging occurs after scan conversion, see col. 9 lines 32 – 35. (Claim 5).

In Heimdal et al the strain derivative is calculated for point velocities with respect to range. (Claim 6).

Weighting is practiced in Heimdal et al during the interpolation described in col. 9 lines 28 – 31 since spatial interpolation weights the contribution to a pixel or voxel from the contributing data points dependent upon their proportionate distances. (Claim 8).

Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Heimdal et al in view of Criton et al as applied to claim 1 above, and further in view of applicants' para [0003] line 1 – 3 admission. That is, since Criton et al in

col. 15 suggest display in 3D format of strain rate gradient, it would have been inherently obvious to display in a conventional rendered ultrasound 3D display format, where a view and/or cut plane is selected and the 3D data set is rendered as a two-dimensional display.(Claim 2)

Claims 9-10, 13, 15-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Heimdal et al in view of Criton et al as applied to claim 1 above, and further in view of Torp et al (US6676599).

The former are silent as to calculating spatial derivatives in the Cartesian system as a function of the matrix multiplication of gradient vectors in the acoustic domain, as well as specific instructions to resample and blend data along raylines and delay data.. It would have been obvious however in view of Torp et al col. 5 lines 56 – 61 considered together with col. 12 line 32 – col. 14 line 58 .that a spatial velocity gradient or strain rate may be converted by angle offsets in two or three-dimensions in order to compute strain rate along any convenient direction. In the 3D case the coordinate corrections are carried out by matrix operations on the gradient vectors, see col. 14. As a result, the gradient vectors as produced in the former references and converted to Cartesian coordinates would have been derived from matrix multiplication of neighboring vectors. It would have been obvious to do so because the motivation in Torp et al, namely to produce meridianal and transmural strain rate or gradient values across or along the heart wall in directions not directly facilitated by scanline aiming carries forward to Torp's later work as co-inventor

to Heimdal and also Criton et al is assigning strain rate or gradient values to the heart wall hence transmural orientation is desirable. (Claim 9).

Further, noting that in Heimdal et al the scan conversion involves interpolation, then Torp et al evidences that matrix multiplications arise during coordinate transformations and therefore would arise during spatial interpolation amongst gradient vectors during conversion spatial interpolation. (Claim 10).

Additionally, the directional transformation computation for the velocity spatial gradient or strain rate in Torp et al as discussed above regarding claim 9 would include a Cartesian transformation if desired since the coordinates used are stated to include Cartesian coordinates. (Claim 13).

Also, the conversion and re-sampling to a transmural gradient vector is tantamount to selection of a viewing direction for optimizing the cardiologist's analysis of the data in Torp et al (Claim 15).

The re-sampling associated with gradient vector re-alignments along a desired direction orientation in Torp et al would thereafter be followed by spatial interpolation and spatial and temporal filtering, the interpolation and spatial filtering both being describable as 'blending along raylines' as a result of the re-sampling. (claim 16).

Delay-alignment of adjacent scanlines is intrinsic to performing accurate coordinate transformations and data shifts. (Claim 17).

The transformation in three-dimensional coordinates for a gradient set in Torp et al literally involves re-determining plural gradients along the first, second and third new alignment directions. (Claim 18)

Claims 21-22, 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sano et al (US6064391) in view of Cline et al (US5412563)..

Sano et al is directed to a method for efficient three-dimensional medical image rendering from data acquired from stacked 2D scanplanes (col. 1 lines 6-13), appurtenant to which is the computation of spatial voxel gradients or derivatives based upon the gray-level intensities between voxels of the image data, see col. 2 lines 28 – 49., the method comprising:

(a) shading the image data of the three-dimensional volume as a multiplicative product of incident light and voxel value in dependence upon the normalized spatial gradient of the voxel surface, and

(b) re-sampling the shaded data to lines representing a view-angle or incident raylines for the viewing direction orf the 3D image data, see col. 10 lines 6 – 11.

Sano et al does not specifically designate ultrasound images as opposed to CT or MRI type. However the process is stated to be broadly applicable to stacked 2D scanplane images, whereupon it would have been obvious in view of Cline et al to modify Sano et al to be operative upon ultrasound images since the shading alteration of ultrasound images in a 3D volume based upon the surface gradient of the stored ultrasound data was well-known as evidenced in Cline et al, see col. 3 lines 48 – 58. (Claims 21, 25).

While Sano et al is silent to the feature, smoothing processes i.e. interpolation a form of spatial blending would expectedly accompany a re-

sampling of the initial voxel grid to an arbitrary view direction; additionally surface normal gradient operations practice interpolative smoothing or blending as well, see Cline et al col. 8 lines 63 – 68. (Claim 22).

Claim 23 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sano et al in view of Cline et al as applied to claim 21 above, and further in view of Schwartz (US5720291). Although Sano et al does not elaborate upon opacity weighting, the step 910 of fig. 9 is inferential of opacity weighting or shading during volume view rendering, whereupon it would have been obvious in view of Schwartz in the case of ultrasound to opacity weight via 130, 140 applied to the images viewed as a stack along viewline 70 of Fig. 4 in order to provide a volume rendering as generally taught in Sano et al. (Claim 23).

Claims 21 and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sano et al in view of Cline et al and Odell(US5268877) or Ri et al (US5615679)..

The former are applied as above, except that Cline et al evidences that ultrasound would be a modality of medical imaging embraced by Sano et al. However now the term 'shading' is given its broadest reasonable interpretation in this art, meaning 'received image data weighting' whereupon it would have been obvious to practice aperture shading in the acoustic domain prior to any scan conversion such as taught in Odell col. 2 lines 43 – 46., and alternatively, it would have been obvious in view of Ri et al to literally apply view shading

weights via 21 in Sano et al in view of Cline et al to data to be imaged prior to scan conversion at 13 in ri et al in order to enhance blood vessels within anatomic images. (Claims 21, 24).

Allowable Subject Matter

Claims 3, 7, 11 – 12, 14, 19 –20, 26 - 27 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Cline et al (US5433199) teaches gradient-based segmentation as well as surface gradient shading, this is based upon normal pixel intensity spatial gradients indicative of tissue boundaries and not strain rate gradients, and its latter function relates to applicants para [0004] prior art discussion.

Any inquiry concerning this communication should be directed to Jaworski Francis J. at telephone number 703-308-3061.

FJJ:fjj

9-24-2004

Francis J. Jaworski
Primary Examiner